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## A Successful Collaborative Research Project: Determining the Effects of Delayed Castration on Beef Cattle Production and Carcass Traits and Consumer Acceptability

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## A Successful Collaborative Research Project: Determining the Effects of Delayed Castration on Beef Cattle Production and Carcass Traits and Consumer Acceptability

### Abstract

A cooperative, on-ranch study was conducted to determine the effect of time of castration on ADG, carcass characteristics, and consumer preference. Sixty-five bull calves were randomly assigned to three treatments: early castrates (E), weaned castrates (W) and late castrates (L). Results indicated no differences between treatments for ADG, backfat, ending live weight, hot carcass weight, or dressing percentage. Ribeye area and cutability were higher for the L, and marbling score and yield grade were lower for L. Consumer panelists who ate beef regularly identified E as more tender, juicy, and flavorful and had better overall acceptability than W or L.

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## Introduction

Delayed castration as a means to improve live animal performance was of interest to ranchers and Extension agents and specialists throughout the western United States. However, there are many ranches that retain ownership of their calves through harvest and have expressed concern about the effects delayed castration may have on carcass and consumer acceptance qualities of the beef produced. A southern Utah rancher discussed these issues with the county Extension agent, and together they developed an applied research project in collaboration with the Extension beef specialist and meat scientist.

Delayed castration of beef calves has been suggested to improve live animal performance (ZoBell, Goonewardene, & Ziegler, 1993). Typically, bull calves are castrated at less than 3 months of age. Young bulls, however, have been documented to be very efficient producers of lean meat (Field, 1971; Klastrup, Cross, Schanbacher, & Mandigo, 1984; Seidman, Cross, Oltjen, & Schanbacher, 1982). Despite excellent production traits, bulls can be aggressive in confinement and may produce high-yielding, lower quality carcasses that lack acceptance in the market place. Research indicates that bull carcasses compared to steer carcasses have less marbling, lower USDA quality grades, darker lean color, and lower tenderness (Seidman, Cross, Oltjen, & Schanbacher, 1982). In addition, meat packers penalize bull carcasses with discounted prices. If castration management could produce accelerated gain without the negative bull carcass traits, delaying castration could be an alternative for livestock producers.

The objective of the collaborative research project reported here was to determine the effect of time of castration on ADG, carcass characteristics, and consumer preference.

## Materials and Methods

A progressive cattle ranch within the county was selected for this study as they had the facilities, personnel, and understanding required to complete the project. The research activities also corresponded to the ranch's management activities. During the spring roundup, 65 bull calves were randomly assigned to three treatments: Early (E) - castrated prior to 90 days of age (106 kg); Weaned (W) - castrated at 225 days of age (243 kg); and Late (L) - castrated at 380 days of age (365 kg).

The trial started on June 1, 2001, when the E calves were castrated. All cow-calf pairs were then pastured as a group on mountain meadows and weaned October 15. At that time all calves were weighed and received the appropriate vaccinations recommended by the local veterinarian.

All calves that were castrated were implanted with Ralgro and given an injection to prevent tetanus. Calves were castrated using a bloodless technique (Callicrate Smart Bander, No-Bull Enterprises LLC, P.O. Box 748, St. Francis, KS 67756).

The treatment groups were fed together during the entire feeding phase (Oct 15 to harvest). During the background feeding phase, the calves were fed 2.5% of their body weight (DMB) a diet consisting of 19% alfalfa hay, 27% oat/triticale hay, 36% wheat midds, and 18% rolled corn (DMB). The finishing diet consisted of 73% rolled corn, 8.2% corn silage, 9.4% alfalfa hay, 4.7% whole cottonseed, and 4.7% calf supplement with free choice trace mineralized salt (DMB).

The age of the dams ranged from 3 to 8 years of age. The calves were weighed individually at the beginning, four times throughout the 424-day period, and at the end of the trial.

The steers were harvested at a USDA inspected, commercial beef processing plant. Calves were sent to slaughter as a group based on days on feed and average group weight. Individual carcasses were measured for rib eye area (REA), marbling score (MS), yield (CY) and quality grade (QG), back fat thickness (BF), and carcass weight (CW).

Five carcasses from each treatment were randomly selected, and one ribeye from each carcass was removed for taste panels and tenderness studies (n=60). The ribeyes were aged for 10 days, which is similar to a commercial situation. Two untrained consumer taste panel evaluations were completed at the Utah State University consumer taste panel laboratory. Panel #1 was composed of working professionals, and panel #2 was college students. Steaks were cooked to an internal temperature of 74° C, which corresponds to a medium well done rating.

Treatments were given a three-digit code, and panelists rated the samples on a 1-9 scale for tenderness, juiciness, flavor, and overall quality. The rating scale was as follows: 1 = dislike extremely, 2 = dislike very much, 3 = dislike moderately, 4 = dislike slightly, 5 = neither like nor dislike, 6 = like slightly, 7 = like moderately, 8 = like very much, and 9 = like extremely. Panelists also indicated their age and how often they eat steak.

Warner-Bratzler (G. R. Electric Manufacturing Co., Manhattan, KS) shear force was measured as an indicator of tenderness of cooked steaks. Three steaks were randomly selected from each treatment (E, W, or L treatments) for shear force measurements. After cooking, steaks were cooled 30 minutes at room temperature. Then 1-cm diameter cores (five per steak) were taken parallel to the muscle fiber axis, so that shearing was perpendicular to the fiber axis.

Statistical analysis for the analysis of ADG and carcass traits were performed using the MIXED procedure of SAS (SAS Institute, Cary, NC) using a completely randomized design with a repeated measures treatment structure with animal as the experimental unit. Statistics for consumer taste panel evaluation of steaks from E, W, and L steers were performed using Statistica (Statsoft Inc., Tulsa, OK). Treatment means were calculated by one-way ANOVA and significant differences between means determined by calculation of Fisher's LSD values, when appropriate.

## Results and Discussion

There were no differences in live animal performance between treatments throughout the trial ( $p \leq 0.05$ ) (Table1).

**Table 1.**

The Effect of Age at Castration of Beef Males on ADG ( $\text{kg}\cdot\text{d}^{-1}$ )

Period	Early (E)	Weaning (W)	Late (L)	SEM	P
0-136d	1.00	1.05	1.07	0.08	0.40

136-252d	0.77	0.69	0.67	0.08	0.18
252-291d	0.99	1.00	1.02	0.08	0.32
291-385d	1.23	1.25	1.16	0.09	0.32
385-424d	1.45	1.43	1.58	0.09	0.07
Overall	1.09	1.08	1.10	0.04	0.89
a,b Different superscripts in the same row are significantly different between means (P<0.05).					

At harvest, dressing percent and hot carcass weights were not different between treatments (Table 2). Marbling scores decreased significantly in the later castrates. Eighty-seven percent of treatment E graded choice or better and 75% and 47.6% of treatment W and L, respectively, graded choice or better. Kidney, pelvic heart fat (KPH), and back fat (BF) were similar for all treatments. Delaying castration increased ribeye area (REA) and cutability. Yield grade is determined largely by REA and BF. Delayed castrates showed significantly lower yield grades reflecting increased red meat yield.

**Table 2.**  
The Effect of Delaying Castration of Beef Males on Carcass Weights and Carcass Characteristics

<b>Variable</b>	<b>Early (E)</b>	<b>Weaning (W)</b>	<b>Late (L)</b>	<b>SEM</b>	<b>P</b>
Live wt. (kg)	577.9	568.7	565.8	15.3	0.73
Dressing %	61.4	60.7	61.2	0.98	0.82
Hot wt (kg)	355	344.9	349.9	11.7	0.69
Marbling score	5.89 <sup>a</sup>	5.73 <sup>a</sup>	4.99 <sup>b</sup>	0.24	0.001
KPH (%)	2.40	2.38	2.38	0.15	0.98
REA (sq cm)	81.2 <sup>a</sup>	82.8 <sup>a,b</sup>	87.1 <sup>b</sup>	2.45	0.06
Back fat (cm)	1.25	1.07	1.09	0.13	0.23
Cutability (%)	49.4 <sup>a</sup>	50.3 <sup>a,b</sup>	50.6 <sup>b</sup>	0.35	0.01
Yield grade	3.15 <sup>a</sup>	2.80 <sup>a,b</sup>	2.67 <sup>b</sup>	0.15	0.01
a,b Different superscripts in the same row are significantly different between means (P<0.05).					

The demographics of the consumer taste panel results were variable, which resulted in mixed results. Taste panel #1 was made of participants who were older, 30-40 years of age, and ate beef

steak regularly, 1-3 times a month. Taste panel #2 panelists were younger, 20-30 years, and ate beef steak less than once a month. The 62 panelists of taste panel #1 identified the early castrates as significantly more tender, juicy, and flavorful than either of the delayed castrate treatments. Overall acceptability was rated higher for early castrates and was different from the other treatments ( $P < 0.05$ ) (Table 3). The 77 participants of panel #2 indicated that the early castrates were less juicy than the other treatments ( $P < 0.05$ ) (Table 4). No differences were detected in flavor, tenderness, or overall acceptability between panelists.

**Table 3.**

Consumer Taste Panel #1. The Effect of Delaying Castration of Beef Males on Tenderness, Juiciness, Flavor, and Overall Acceptability

Variable	Early (E)	Weaning (W)	Late (L)	SEM	P
Tenderness	7.48 <sup>a</sup>	6.95 <sup>b</sup>	6.90 <sup>b</sup>	0.20	.04
Juiciness	7.50 <sup>a</sup>	6.96 <sup>b</sup>	6.75 <sup>b</sup>	0.20	.01
Flavor	7.00 <sup>a</sup>	6.24 <sup>b</sup>	6.35 <sup>b</sup>	0.20	.02
Overall	7.37 <sup>a</sup>	6.56 <sup>b</sup>	6.73 <sup>b</sup>	0.20	.05

<sup>a,b</sup> Different superscripts in the same row are significantly different between means ( $P < 0.05$ ).

**Table 4.**

Consumer Taste Panel #2. The Effect of Delaying Castration of Beef Males on Tenderness, Juiciness, Flavor, and Overall Acceptability

Variable	Early (E)	Weaning (W)	Late (L)	SEM	P
Tenderness	6.64	6.84	6.62	0.20	0.64
Juiciness	6.24 <sup>a</sup>	6.98 <sup>b</sup>	6.67 <sup>b</sup>	0.20	0.01
Flavor	6.70	6.66	6.53	0.20	0.73
Overall	6.50	6.76	6.66	0.20	0.49

<sup>a,b</sup> Different superscripts in the same row are significantly different between means ( $P < 0.05$ ).

Early, W, and L castrates had Warner-Bratzler shear measurements of 3.80, 4.04, and 4.21, respectively ( $P > 0.05$ ). Shear force measurements above 6.0 indicate unacceptable tenderness and an increased likelihood of consumer dissatisfaction.

## Conclusions

These results were provided to the cooperating ranch and others within the county and state. Results indicated that there were no advantages in ADG or ending live weight when calves were left intact. There were, however, significant differences for late castrated calves on various carcass characteristics, including increased REA and decreased MS.

Delayed castration may offer a marketing potential for area livestock producers desiring to market

a leaner carcass. Consumer evaluations showed that improved tenderness, juiciness, flavor, and overall acceptability could be identified in the early castrated treatment. This data suggests that in order to produce a quality consumer product, it is recommended that calves be castrated early unless they are managed differently.

As a result of the study, the cooperating rancher has since changed his castration management to the early castration or traditional treatment to take advantage of higher marbling carcasses that improve consumer acceptability and value of the carcass at marketing. Dissemination of the results has provided further Extension opportunities within the county, the state, and the surrounding western states. Extension specialist and agents can also utilize the study as a model for conducting on ranch research projects.

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